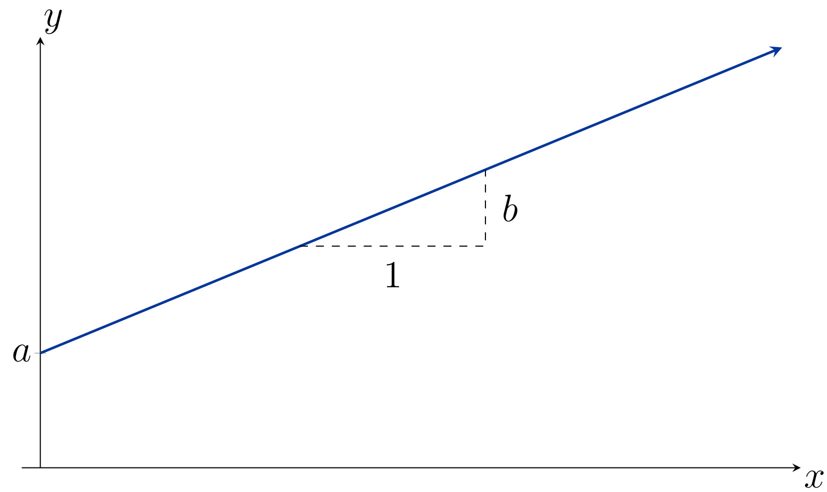
4.3: Modeling Linear Trends

Definition.
The **regression line** is a model used for making predictions about *future* observed values. The equation of the regression line is

$$y = a + bx$$

where a is the y**-intercept** and b is the **slope**.



The input variable x is known as the

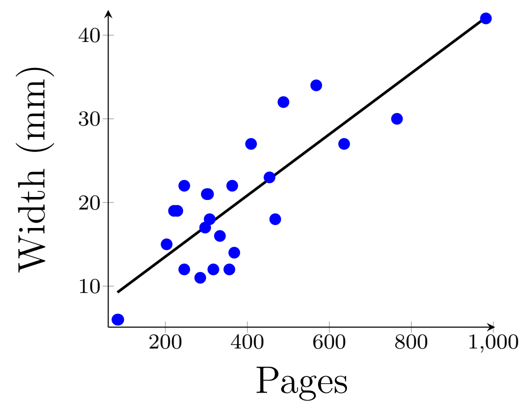
- Independent variable
- Predictor variable
- Explanatory variable

The output variable y is known as the

- Dependent variable
- Predicted variable
- Response variable

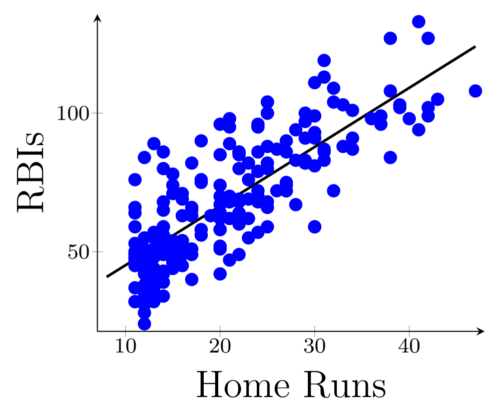
Example. Below is a scatterplot comparing number of pages a book has against the width of the book. Interpret the intercept and the slope of the regression line.

Predicted Width=6.22+0.0366 Pages



Example. Below is a scatterplot comparing the number of home runs and RBIs in the 2016 season. Interpret the intercept and slope of the regression line.

Predicted RBI=23.84+2.13 HR



Definition.

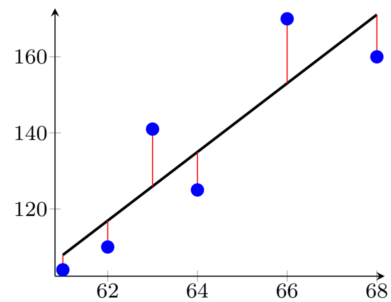
Now we define the formula of the regression line:

$$y = a + bx$$

Where

$$b = r\frac{s_y}{s_x} \quad \text{and} \quad a = \overline{y} - b\overline{x}.$$

These formulae minimize the residual error: Try this!



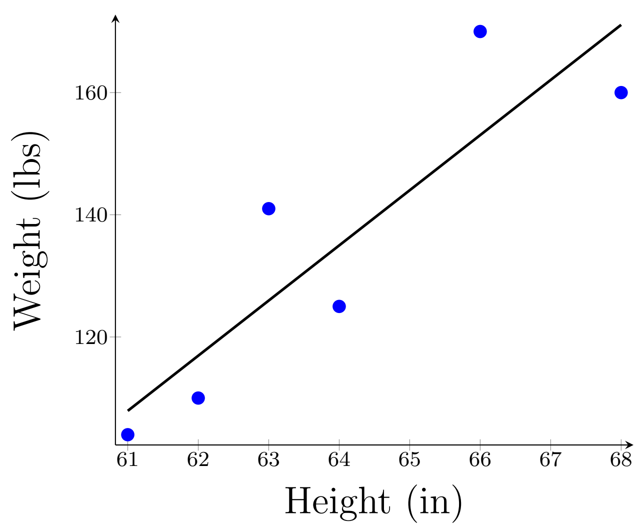
Example. Below are the heights and weights of six women:

Heights	61	62	63	64	66	68
Weights	104	110	141	125	170	160

From this we get

$$\overline{x} = 64 \qquad s_x = 2.608$$
$$\overline{y} = 135 \qquad s_y = 26.728$$
$$r = 0.881$$

Find the equation of the regression line.



Example. Open the `popdensity_and_crime` dataset in StatCrunch, use the "Simple Linear" tool under the `Stat⟩Regression` menu to find the regression line for the following columns. Interpret the slope and intercept where appropriate.

the `pop1990` and `pop2000` columns,

the `pop2000` and `totcrimerate` columns, and

the `pop2000` and `Rank Pop` columns.

4.4: Evaluating the Linear Model

Guidelines:

- Don't fit linear models to nonlinear associations!

- Correlation is not causation

- Beware of outliers (a.k.a. **influential points**)

- Don't extrapolate (make predictions beyond the range of the data)

Definition.
The **coefficient of determination** is the correlation coefficient coefficient squared:

$$r^2$$

This is sometimes also called r**-squared**.